Development of a remedial course for students who attend classes of circuit theory

Development of a Remedial Course for Students Who Attend Classes of Circuit Theory

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1 Introduction

This paper describes a remedial program that has been designed to help students who attend classes of Circuit Theory. It is an asynchronous self-learning course that contains a number of modules, corresponding to the main topics taught in a standard Bachelor course of 8 ETCS. However, the underlying idea has general validity and can be applied in any discipline. Evidence of its efficacy is reported based on the performance of the students at the final exam.

2 Course Organization and Students' Recruitment

The course is implemented on the Moodle platform and is organized in asynchronous weekly modules, dedicated to the topics presented during the class lectures. Each module consists of three main items:

- A "check-in" test that is used to preliminarily assess the student's level of preparation. The test consists of randomized problems, similar to exam tests. It can be attempted only once and, if the result is below a pre-set threshold, the student must attend the remedial learning units covering the topic.
- "Learning units", consisting of one or more short instructional videoclips that briefly summarize the main theoretical concepts, and a set of exercises. Some exercises are solved and discussed in the video clips, whereas additional practice problems are left to the students in the form of quizzes. The access to the learning units is conditional on failing the corresponding check-in test. This is achieved through a dedicated Moodle feature.
- A "check-out" test, having the same structure of the check-in test, that is used to ascertain the student's progress. The test can be attempted only after all lesson activities have been successfully completed, which is tracked using the "activity completion" feature in Moodle, and for a maximum of three times, in order to earn the associated credit, as mentioned later on.

The remedial program was implemented for the courses of Circuit Theory in the Bachelor program of Biomedical Engineering at Polytechnic of Turin, Italy, during academic year 2021-22. Eventually, 13 modules were designed, each covering roughly the material of one week of lectures and made available at the end of it.

The participants were recruited on a voluntary basis at the beginning of the semester. Students who already attended classes in the past years, and failed the exam, were warmly encouraged to enroll. A bonus of up to 4 points on the final exam score, out of a maximum of 30 points according to the Italian grading system for university exams, was introduced to further encourage participation, and could be earned based on the cumulative performance at check-in and check-out tests. Specifically, for each of the 13 modules, a full score of 4/13 points was awarded if the check-in test was passed, whereas 2/3 or 1/3 of the above score was earned by the students who had to follow the remedial program and passed the check-out test on the first attempt or with multiple attempts, respectively. Eventually, 185 students enrolled in the remedial course, out of a total of 406 students enrolled in the regular classes. This was a satisfactory result, which led to two fairly balanced populations and allowed for a comparative assessment.

3 Analysis of Results

The students who attempted the final exam in the first available session were 256. Out of these, 141 completed a significant part of the remedial course. A small number of students, who only took a minimal part of it, were excluded from the following analysis.

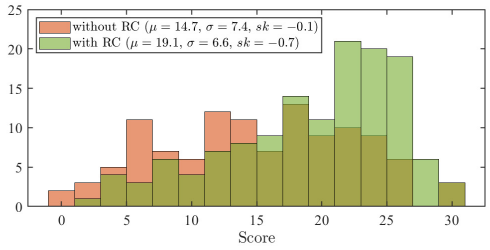

Fig. 1. Comparison between the scores obtained by the students who have (green) or have not (red) attended the remedial course.

The histogram in Fig. 1 illustrates the results achieved by the students. The score distribution of the population who followed the remedial course (in green) is shifted towards the highest grades compared to the score distribution of the remaining students (in red). Indeed, as reported in the legend, the average μ of the green distribution is 19.1, compared to 14.7 of the red distribution. Therefore, a remarkable average improvement of over 4 points out of 30 was achieved by the students who followed the remedial program. Furthermore, it is interesting to note that the skewness coefficient sk is negative for students who have followed the remedial course, which indicates that their score distribution is biased towards the highest scores, whereas it is close to zero for the remaining students, denoting a symmetric dispersion around the average.